2.0 WATERSHED AND REACH INFLUENCES

2.1 Watershed and Local Geology

Two large scale geologic processes influence the geomorphic evolution of the middle Rio Grande valley: extensional faulting parallel to the valley, or rifting (Chapin, 1988), and volcanism both within the watershed producing rhyolitic through andesitic rocks (Morgan et al, 1986) and along the mainstem river producing andesitic through basaltic rocks (R. M. Chamberlin, and W. C. McIntosh, N.M. Bureau of Mines and Mineral Resources, N.M. Geochronolgy Research Lab, unpub. data, written commun., 2000; and Morgan et al, 1986). Extensional faulting, associated with the Rio Grande rifting has created a north-south extending valley, in which the Rio Grande valley is subsiding relative to the mountains which are uplifting. This rifting valley is partially filled by debris (sediment) originating from the mountains, volcanism and sediments transported by the Rio Grande which are estimated to be up to 5,000 feet thick (Hawley, 1978) in the Socorro area. Lava flows also fill this valley, such as the andesite at San Acacia (R. M. Chamberlin, and W. C. McIntosh, N.M. Bureau of Mines and Mineral Resources, N.M. Geochronolgy Research Lab, unpub. data, written commun., 2000).

Two local geologic features/processes greatly influence the San Acacia reach: the andesitic volcano at San Acacia, and a magma body beneath the surface in the San Acacia area, also known as the Socorro Magma Body. The andesitic lava located at San Acacia (R. M. Chamberlin, and W. C. McIntosh, N.M. Bureau of Mines and Mineral Resources, N.M. Geochronolgy Research Lab, unpub. data, written com., 2000) is present on both sides of the channel, creating a naturally narrow or confined section of the Rio Grande. Argon-Argon dating of these rocks indicate that the magma eruption occurred approximately 4.87 ± 0.04 million years ago (R. M. Chamberlin, and W. C. McIntosh, N.M. Bureau of Mines and Mineral Resources, N.M. Geochronolgy Research Lab, unpub. data, written com., 2000). Landslides in this volcanic material originate from both sides of the river, which may have further constricted the Rio Grande. These landslides also provide large bed material which is not readily transported by river processes. Although no dates have been established for the landslides, earlier photographs from 1906, clearly show that the west-side landslide had already occurred (Scurlock, 1998). A strath terrace (a terrace in which river sediments overlie an eroded bedrock surface) is located immediately downstream of the landslide deposits. Although this terrace has not been dated either, historic photos indicate that it was also formed prior to the 1900's.

The other main geologic influence on this reach is differential uplift associated with the rise of a magma body (Sanford et al., 1973; Sanford et al., 1977; Brown et al., 1979; and Larsen and Reilinger, 1983). The center of uplift, located approximately 2 miles (3 km) upstream of the study reach (Larsen and Reilinger, 1983; and Ouchi, 1983), was rising at an estimated rate of 1.8 ± 0.5 mm/yr between 1951-1980. Since uplift rates are not uniform (the center of the magma body is rising faster than the flanks), surface slopes downstream of the center of uplift are increasing, while slopes upstream from the center are decreasing. Also, extensional faults have been found in two fluvial terraces that are both less than 50 years old downstream of San Acacia (Figure 2): the visible fault lines appear generally consistent with extensional faulting and hence, surface uplift from a magma body.

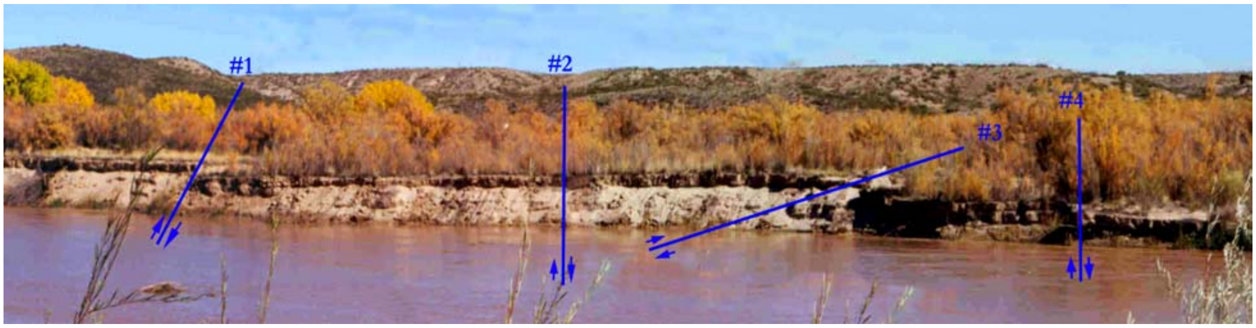

Figure 2: Faulted surface (fault #1 is upstream of fault #4) along the Rio Grande, San Acacia Reach.

2.2 Human Influences

The Middle Rio Grande valley is one of the oldest agricultural areas in the United States, reaching a peak of irrigated lands in 1880 at 124,000 acres (Lagasse 1980). Due to the progressing decrease in irrigated lands after 1880 and flooding in the early part of the century, the U.S. Congress authorized the Rio Grande Reclamation Project in 1905 and later the Rio Grande Comprehensive Plan, authorized in the Flood Control Acts of 1948 and 1950. These acts authorized the rehabilitation of the Middle Rio Grande Conservancy District, river channel rectification, maintenance, and sediment/flood retention dams to be built along the Rio Grande and its tributaries. The purpose of these acts was to reduce and reverse river aggradation, increase agricultural land use, protect important river side facilities, provide valley drainage along the Rio Grande and increase water delivery to Elephant Butte Reservoir under the Rio Grande Compact. Most of the levees, riverside drainage canals and small diversions dams were built in the 1930's and are administered by the Middle Rio Grande Conservancy District. The sediment and water storage dams upstream of San Acacia were built between 1953 (Jemez Canyon Dam) and 1973 (Cochiti Dam), including the Gallesteo dam. During the same period, Kellner jetty jack systems and stream-side drainage canals were rehabilitated along the Rio Grande. Along with the levees and stream-side canals, this period also saw the re-alignment and straightening of the Rio Grande floodway: an activity which still affects floodway morphology today.

Engineered structures/features in the study reach consist of an irrigation and water delivery diversion dam, levees, riverside railroad line, Kellner jetty jack lines and a bridge crossing. San Acacia diversion dam was built in 1935 and currently diverts water into the Socorro Main diversion canal and the Low Flow Conveyance Channel (LFCC). Located between two andesitic outcrops, the diversion dam is in a naturally narrow section of the Rio Grande. The river channel bed downstream of the dam is lined by boulder-sized sediment, rock debris from the andesite, and rip-rap placed after construction of the dam. The persistently narrow channel downstream of the dam is confined for about 0.5 miles by the Atchison Topeka & Santa Fe Railroad line. The remaining 10 miles of the reach is confined by abandoned river surfaces and the levee. The levee was originally constructed from the LFCC spoils in the mid-1950's (Chris Gorbach, USBR, pers. comm., 1999) and is located on the west (right) side of the river, and extends past the Escondida Bridge. Smaller, unconnected spoil piles that act as local levees are located throughout the reach, mostly on the right bank. These spoils appear to originate from realignment efforts of the floodway during the building of the LFCC. The Kellner jetty jack lines were constructed in approximately the 1950's, and are located on the historic floodplain along the levee. These jetties were originally constructed to protect the levee from bank erosion and channel avulsions. Nearly all the jetty jacks are still in place. The Escondida bridge was built prior to the 1950's in a naturally narrow section of the Rio Grande; the Rio Grande channel/floodplain is impinged by the distinct debris fan from the Magdalena Mountains to the west and ancient river sediments to the east. After these large-scale channel modifications were completed, riparian vegetation clearing and stream cleaning of vegetation debris, which continued into the in the 1980's (Drew Baird, USBR, pers. comm., 1999), were the prominent form of channel maintenance in this reach.